

PREFERENTIAL FLOW IN GAS MASK FILTER

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ABSTRACT

Generally gas mask been used in a condition that needed a protection of the respiratory from inhale such hazardous gases within in the air surrounding. However, the standard production of a gas mask filter does not sync with the certain condition such as climate issues that affiliated with humidity as it can affect the filtration rate performance. By construct the geometry of the filter and using Computational Fluid Dynamics (CFD) will help simulate the preferential flow and showing the region of the absorption taken in place where either humidity had such influence towards the filtration. The conclusion behind this study is the climate are vary upon places and region which making the standard performance and usage life of filter affected also this gave an opportunity to look into improving the gas mask filter even more.

KEYWORD

Gas Mask Filter, CFD, local Climate

INTRODUCTION

Chemical gases and other airborne particles that effecting the health commonly been categorized as hazardous which it can be filtered or cleaned out from the air while you breathe using an equipment called gas masks or also referred to "air-purifying respirators." This respirator comes with a face piece or mask, a filter or cartridge, or a "canister" if the filter is housed in a metal shell. The face piece is fastened to the head via straps. The cartridge as in figure 1 below may have a charcoal filter or porous media material to absorb particular chemicals, a filter to remove particles (like a biological weapon), both, or other components.



Figure 1: The Gas mask and the filter

The shelf life expectancy provided for if they were stored unopened in the original packaging and away from direct sunlight, humidity and sources of high temperature, cartridges will last five years from manufacture date but once opened, maximum use time is 6 months (3M Australia). However based on the industry feedback towards their experience in using the gas mask, the life expectancy was much faster as it should be, where the filter been replace as early one month after used. There's have a correlation between the filtration and exposure to the humid climate that actually speed up the expiry date of the filter even though the expiry date set by the manufacturer is still valid (Brochocka & Makowski, 2020).

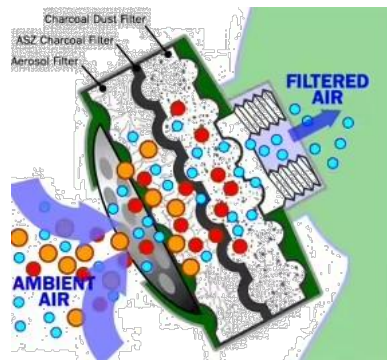


Figure 2: Air direction into gas mask cartridge

Air flowing into the filter will have to face several part of the filtration component and there are several factors influence in the effectiveness of the filtration efficiency. Pressure drop, inhalation resistance and area ratio of the filter has been see with the air flow characteristic and resistance. Air age index also been taken into account as it providing the information related to the aerosol reside a long the filter domain that indicates the capabilities in rate of absorption.

However gas and vapour cartridge's inhalation pressure drop especially can be reduced using one of the two methods, which first modifying the porous media parameters and adjusting the absorbent formula or second by modifying the passageway design within the canister to reduce the superficial velocity V_s and adsorption layer thickness L . This must comes with the comply of the aerosol penetration and gas breakthrough inspection standards (Noraini et al, 2022). Based on the past suggestion, by redesigning the perforated screen or main sieve passageway will much optimal way rather adjusting absorbent porous media parameters. The honeycomb main sieve design had been studied and simulate which it capable enhanced the flow rectification and increased the passageway sizes, thus improving the effective flow-through area and reducing the inhalation resistance (Noraini et al, 2022).

MATERIAL AND METHODOLOGY

Computational fluid dynamics, or CFD, is the science of forecasting fluid flow, heat transfer, mass transfer, chemical reactions, and related experiments or real-world occurrences using numerical methods to solve the mathematical equations governing these processes. Thus, using mathematical modelling, numerical methodologies, and software tools, CFD simulation provides a qualitative and quantitative forecast of fluid flow needed to analyse the preferential flow in the filter.

RESULT AND DISCUSSION

Expectation of the result is to see either the humidity had bring such impact towards the preferential flow in the recite filter. Figure 3 below shows that on a constant temperature of 30C with adjustment humidity of 80%, and 1000ppm of filter concentration shows significant of pressure drop (Yin-Chia & Chun-Li, 2015).

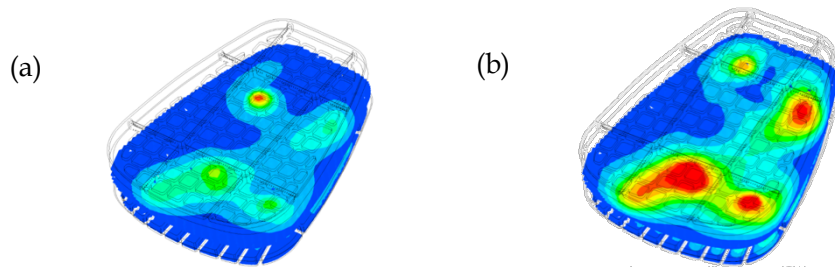


Figure 3: (a) Case III- Temperature at 30°C, the humidity of 70 % and filter concentration of 200ppm and (b) Temperature at 30°C, the humidity of 80 % and filter concentration of 1000ppm

CONCLUSION

In conclusion, the high pressure drop, with circulation of air with additional of higher humidity ratio in the mask filter will retain the heat inside the gas mask filter, thus reducing the life cycle of the filter.

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